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ABSTRACT

Industrial expansion remains essential for the development and structural transformation of most sub-Saharan African economies. The advantages of industrialization go beyond the provision of manufactured goods and the diversification of exports to the modernization of society. Growth rates in formal manufacturing tell little about the economic benefits and sustainability of the industrialization process in Africa. Industrial development is beset by a pattern of negative interaction among policy incentives, capabilities, and institutions that has held back growth and, in some cases, led to a vicious spiral of decline. The region has a rich supply of natural resources and primary export products, but only a tiny core of industrial skills. It has built up physical capacity too quickly for its capabilities, institutions, and infrastructures to cope. The industries that have been set up have been highly protected, tightly controlled, and, in many cases, run by incompetent public sector organizations. The stock of skills and technical knowledge needed to manage these industries has grown, but not rapidly enough to lead to substantial gains in efficiency. Each country can act in some fashion to improve conditions in policy incentives, capabilities, and institutions, including implementation of a policy of selective intervention, education and training to produce trained workers, stimulation of technological activity relevant to manufacturing industries, and building up of management capabilities. (Contains 35 references.) (YLB)

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EDUCATION, SKILLS AND INDUSTRIAL DEVELOPMENT IN THE STRUCTURAL TRANSFORMATION OF AFRICA a/

by

Sanjaya Lall b/

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SPECIAL SUBSERIES

STRUCTURAL ADJUSTMENT IN SUB-SAHARAN AFRICA

EDUCATION, SKILLS AND INDUSTRIAL DEVELOPMENT IN THE STRUCTURAL TRANSFORMATION OF AFRICA a/

by

Sanjaya Lall b/

July 1990

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CONTENTS

I.	INTRODUCTION	1
II.	THE NEED FOR INDUSTRIALIZATION	3
III.	BACKGROUND TO INDUSTRIAL DEVELOPMENT IN AFRICA	4
IV.	AFRICAN INDUSTRIAL PERFORMANCE	9
	A Framework for Analysing Industrial Success	9
	Policy Incentives, Capabilities and Institutions in Africa	14
V.	THE POLICY IMPLICATIONS FOR AID DONORS AND FOR AFRICA	27

TABLES

I.	GDP AND MANUFACTURING GROWTH RATES	5
II.	GROSS ENROLMENT RATIOS IN EDUCATION	17
III.	EDUCATIONAL ATTAINMENT IN SUB-SAHARAN AFRICA	18
IV.	TERTIARY LEVEL STUDENTS IN TECHNICAL FIELDS	20
V.	ENROLMENTS IN SECONDARY EDUCATION	21
VI.	R & D IN SAMPLE AFRICAN COUNTRIES	25

BIBLIOGRAPHY 37

I. INTRODUCTION

Sub-Saharan Africa (henceforth referred to as "Africa") remains one of the least industrialized regions in the world, and the recent experience of much of the modern industry which has been established there has not been a happy one. Production has stagnated or declined in many countries over the last decade. Inefficiency and the impact of global market tremors, exacerbated by poor policies, have caused many industries to drag down local economies rather than act as engines of growth and structural transformation. This is the more worrying because Africa is still predominantly specialized in relatively simple low-technology industries, and its long-term development would entail entry into more complex and demanding activities where technologies are changing rapidly and where the challenges of efficiency and dynamism are far more daunting than they are in traditional activities.

Yet industrial expansion remains essential for the development and structural transformation of most African economies. A continued reliance on primary-sector activities can serve as the basis of sustained growth in only a few countries. Although this is not an argument for neglecting the primary sector, as many African countries have done with disastrous consequences (World Bank 1989), it is a plea for a re-examination of the constraints on industrialization in the region and a consideration of possible ways to overcome these constraints. In the context of this UNICEF-ICDC series on the problems of child and social development, industrialization can certainly play a major and, in some cases, central role.

Section II of this paper considers the importance of industrialization in structural transformation. Section III describes the recent experience in industrial development in Africa. Section IV analyses the main structural weaknesses which would have to be remedied if African industry is to support development fully. Section V concludes with recommendations on the role of internal efforts and foreign contributions.

II. THE NEED FOR INDUSTRIALIZATION

Though the past record and immediate prospects of African industry are not very bright, there is no doubt that industrialization will be critical in the structural transformation of economies in the region over the long term.

The history and experience of developed and developing countries alike show clearly that the process of change from a low-income, low-productivity economy based on traditional agriculture and some manufacturing to one utilizing highly productive modern technologies nearly always requires a sustained period of industrial expansion (Chenery et al 1986).

Industrialization meets the shifts in demand patterns - from simple food consumption to the consumption of other products and from simple to complex manufactured items - that occur in the course of economic growth. It provides for the greater use of intermediate products, as opposed to primary raw materials, that an economy needs in agriculture as well as industry as development occurs. Moreover, export and import patterns change as economies grow, and diversification comes largely from the creation of new exports. The transformation of the service sector also requires intensive collaboration with industry, since much of modern service activity is directly related to manufacturing and draws on industrial products. While it is always possible to import manufactured consumer goods and services, only a very few economies can generate the necessary export revenue entirely from other sectors: primary goods have not proved able to earn continuously increasing amounts, and tourism or offshore tax-haven activity may not provide a sufficient base for sustained growth except in a few tiny, well-located countries.

The advantages of industrialization go beyond the provision of manufactured goods and the diversification of exports. The rise of industry is one of the most powerful agents available for the "modernization" of society: it can alter attitudes, broaden horizons, instill a modern work ethic and facilitate the appearance of complex institutional structures. It creates a demand for new skills and technologies that compels society to enlarge the scientific and educational base. Constant technical progress induces receptivity to change and mobility. The appearance of small-scale industry can lead to a breakdown of traditional social barriers. These spillover effects may be just as significant as the direct contributions of new industry to the production system.

Despite the limited industrial base in Africa (see below), the role of industry can be as catalytic there as it has been elsewhere. Industry can furnish a variety of consumer goods and inputs (implements, chemicals, fertilizers, etc.) to the dominant agricultural sector, as well as the means to raise productivity in that sector. Small-scale manufacturing can spread to rural areas, providing off-farm income and employment to rural populations and enabling more local processing of agricultural produce. Through export diversification and import substitution, efficient industrial activity can

help relieve the stranglehold of foreign-exchange shortages, and it can be a major inducement for regional integration in Africa, clearly a need because development has been constrained by small, fragmented national markets.

To belabour a point which most people would accept and which African governments fully endorse is not necessary. What should be noted, however, is that successful industrialization does not simply mean the physical expansion of manufacturing capacity. The building of factories achieves neither growth nor structural benefits if the factories are inefficient, underutilized, unconnected to the local economy and incapable of generating exports, skills or employment. The quality of the factories may be more important than the quantity. The essence of industrial success lies in the ability to use equipment and facilities fully and efficiently, increase productivity and diversify as conditions warrant in both factor and product markets. To achieve quality in industrialization is far more difficult than to increase quantity, and many of the deficiencies which industrial expansion is supposed to remedy constitute, in themselves, the critical bottlenecks to improved quality.

There are thus the makings of a vicious circle here. Yet many developing countries have broken out of the impasse by taking action to open the bottlenecks. The lessons for Africa are clear. For all but the smallest, remotest or most barren countries, industrialization is a necessary step in long-term economic development. Nonetheless, the industry which is created must be efficient and dynamic if it is to be an engine of structural transformation rather than a drag on growth: the status of "newly industrialized country" (NIC) does not follow from mere investment in factories. The nature of the industry which is established must conform to the ability of the country to operate that industry properly not in the static sense of matching given factor endowments, but in the dynamic sense of changing and increasing them. The vicious circle takes hold only if the requirements of the installed physical capacity outpace the breadth and depth of the capabilities needed to run that capacity effectively. In such a case, there will be inefficiency, but also "negative feedback": industrial experience will not contribute to the generation of new skills and capabilities and will create attitudes and interests that inhibit full development in other sectors.

There are indications that this is just what has happened in many African countries: it is not that too little industry has been set up, but that too much may have been created in the sense that the particular activities which have been launched have been too numerous or sophisticated for the capabilities available. Thus, instead of asking whether Africa should

industrialize, it would be more sensible to ask what sorts of industries should be established and at what pace and, most importantly, what other steps should be taken to ensure that they are operated effectively.

There is a diversity of approaches to industrial growth in Africa that should always be borne in mind when considering broad generalizations. Some of this diversity is brought out in the following section, which provides information on the experience in the region.

III. BACKGROUND TO INDUSTRIAL DEVELOPMENT IN AFRICA

In 1965, manufacturing contributed 9 percent of gross domestic product (GDP) in Sub-Saharan Africa compared to 14 percent in South Asia, 20 percent in middle- and low-income countries, 23 percent in Latin America and 26 percent in East Asia (World Development Report 1989: Table 3, World Bank 1989). By 1987, the manufacturing portion of GDP had risen to 10 percent in Africa compared to 18 percent in South Asia, 24 percent in Thailand, 25 percent in Mexico, 28 percent in Brazil, 30 percent in South Korea and 40 percent in Taiwan. However, manufacturing had a much higher share in a few countries in Africa: out of the 45 countries in the region, manufacturing represented 20 percent or more of GDP in four (Mauritius, Swaziland, Zambia and Zimbabwe), while it represented 10 percent or more in another ten (World Bank 1989: Table 3). At the same time, the share of manufacturing in GDP was stagnant or declined in a number of African countries during the 22 years from 1965 to 1987 (ten countries in the table given in World Bank 1989), while in others manufacturing registered a larger share only because GDP itself was declining rapidly, as in Zambia. With the exceptions noted, therefore, the level of industrialization measured in this way has been fairly low in much of Africa.

The total value of manufacturing value added (MVA) in Africa came to $16.3 billion in 1986, 28 percent of that of Brazil, 46 percent of that of India and 66 percent of that of South Korea (WDR 1988, World Bank 1989: Table 8). Only four countries (Cameroon, Cote d'Ivoire, Nigeria and Zimbabwe) had an MVA of over $1 billion each, while 15 had MVAs of under $100 million each. Among the low-income countries, Nigeria had the largest MVA; among the middle-income countries, Zimbabwe was followed by Cote d'Ivoire and Cameroon.

In terms of growth rates, African industry did fairly well during the period from 1965 to 1980 (8.8 percent per annum). Although growth rates appear

overstated because the initial base was small, it is clear that the first flush of import substitution - built on aid and revenues from generally booming primary product exports - was vigorous. In this period, South Asian manufacturing grew at 4.5 percent, Latin American at 6.8 percent and East Asian at 10.7 percent. From 1980 to 1987, the growth rate for manufacturing in Africa fell to 0.6 percent, while the rate in South Asia rose to 8.0 percent. East Asia kept up a healthy 10.4 percent, but Latin America, beset by debt problems, fell to the same rate as Africa, 0.6 percent (all data: WDR 1989).

Table I shows growth rates for GDP and manufacturing for various groups of African economies during three sub-periods from 1965 to 1987 and, for comparison, for all low-income economies (as classified by the World Bank). Aggregate figures are shown with and without Nigeria because of the large weight of the economy of that country, where manufacturing accounted for nearly one-third of the total MVA in Africa in 1986 and nearly one-half in 1980. From 1980 to 1987, Nigeria's declining MVA (-2.1 percent per annum) dragged the performance of the regional groupings and, thus, that of low-income countries from positive to negative.

The figures in Table I suggest that the slowdown observed for Africa as a whole was in fact confined to low-income economies - which also did poorly in the 1970s - and sharply affected the performance of Nigeria. The

TABLE I: GDP AND MANUFACTURING GROWTH RATES
(% Per Annum)

	GDP			Manufacturing		
	1965-73	1973-80	1980-87	1965-73	1973-80	1980-87
Sub-Saharan Africa	5.9	2.5	0.5	10.1	8.2	0.6
- less Nigeria	4.0	1.7	2.3	N/A	1.9	3.4
Low-income economies	6.0	2.8	-0.4	10.7	10.2	-1.0
- less Nigeria	3.3	1.9	1.4	N/A	1.5	1.4
Middle-income economies	5.2	1.4	3.8	N/A	2.5	6.1
Six most populous economies	7.0	3.0	-0.8	12.0	12.9	-1.3
Sahelian economies	1.0	3.5	2.5	N/A	N/A	N/A
Oil exporters	7.5	2.8	-0.5	13.5	15.0	-1.0
All low-income economies	6.0	4.6	6.1	9.1	8.1	10.3
- less China and India	5.9	4.3	1.7	8.3	10.7	3.9

Source: World Bank (1989): Table 2 of Statistical Appendix.

The figures in Table I suggest that the slowdown observed for Africa as a whole was in fact confined to low-income economies - which also did poorly in the 1970s - and sharply affected the performance of Nigeria. The growth in manufacturing in middle-income countries accelerated in the 1980s, and the performance of Cameroon (8.5 percent per annum from 1980 to 1987), Congo (9.7 percent), Cote d'Ivoire (8.2 percent) and Mauritius (10.9 percent) was fairly impressive by any standards. Low-income countries such as Benin, Burundi and Lesotho turned out growth rates of 5 percent or more in this period.

This is not to deny that a large number of other African countries suffered from low or negative growth in manufacturing during the recession following the second oil crisis (manufacturing had already been stagnating in some for much longer). The worst affected were the Central African Republic, Ghana, Liberia, Nigeria, Sierra Leone, Somalia, Tanzania, Uganda, Zaire and Zambia, and possibly Angola, on which no figures are available. The recession and its aftermath led some countries to adopt the structural adjustment policies of the World Bank, while others tried to adjust on their own or continue with previous policies. There was a widespread decline in real wages in many African countries, even in some which showed positive industrial growth rates. Substantial underutilization of capacity emerged as foreign exchange for imported inputs and equipment was more severely rationed and domestic demand fell. The squeeze on modern industry led to considerable unemployment, with some of the unemployed entering into informal-sector activity.

In Ghana and Nigeria, for instance, the expansion of informal-sector activity was particularly noticeable in the adjustment period. Much of this activity was in low-productivity, low-technology areas which required few imported inputs and which could meet the kinds of basic needs that continue to exist even in hard times. It is important, however, not to "glorify" the resilience and capabilities of the informal sector. The informal sector fulfilled a valuable function by permitting survival, but it remained on the margins of subsistence: economic development would reduce it as people moved into more productive technologies or graduated to more formal activities. It may have provided the seed-bed for some entrepreneurship and new skills (though perhaps informal-sector entrepreneurs do not often upgrade, and the origins of new industrial entrepreneurship in the formal sector may lie elsewhere), but the existing informal sector does not have the dynamism to provide a foundation for sustained growth. Once it is "modernized" with competitive industrial technologies and skills in, say, the Italian mould,

it may well be a source of growth, but this involves the problems of capability and efficiency that also affect the formal sector.

That growth rates in formal manufacturing tell us little about the economic benefits and sustainability of the industrialization process in Africa should be emphasized. For industry to fulfil the lead role expected of it in the process of structural transformation, investments should be efficiently carried out, the resulting facilities efficiently operated and upgraded in line with technological advance, and increasing numbers of linkages established with the local economy. Only this provides the internal dynamism, diversification, export growth and externalities that yield the returns expected of investments. In the absence of operational efficiency and productivity improvements, the industrial sector remains an isolated, almost alien growth on the economy, sucking in resources from other production sectors and surviving, with high import dependence, only behind substantial protective barriers. It does not generate the surpluses or the foreign exchange earnings necessary to sustain its own continued growth and certainly contributes little to other sectors by way of resources or even skills.

There are indications that African industrial growth has been of this sort (see Steel and Evans 1984, Gulhati and Sekhar 1982). It has been highly protected and overwhelmingly inward oriented. Launched primarily by foreign companies or resident non-Africans to serve local markets or process raw materials for export, it has been led later by state enterprises which have sought to substitute foreign ownership by that of Africans. Yet the weakness of indigenous industrial entrepreneurship that shows up most clearly in the paucity of our modern African small-scale industrial (as opposed to informal) activity has not been remedied through such state intervention. Some activities have achieved efficiency, particularly those which have been based on simple technologies, been in existence for a long time and benefitted from good - usually foreign - management, but a very large proportion of industry has not, especially in countries without ready access to a plentiful supply of foreign managerial, entrepreneurial and technical skills. The countries which have the best records of industrialization - Cote d'Ivoire, Gabon, Kenya, Mauritius, Zimbabwe - are the ones which have been able to continue to attract sufficient foreign investments, or draw on expatriates or resident non-Africans. Some 70 percent of top managerial and technical positions in industry in Cote d'Ivoire and Zimbabwe, for instance, are held by Europeans (World Bank country reports).

The degree of inefficiency in African industry seems to rise with the degree of capital and skill intensiveness required by the facilities which

are set up. Yet many traditional industries also display considerable inefficiency in comparison to the standards of other developing regions. Parastatal industries have tended to be among the most inefficient (Nellis 1986). Excess capacity has been rampant, partly for external reasons such as a lack of foreign exchange, but partly also because of the inability to maintain plants locally, substitute local for foreign materials and provide basic technical management. Most African industry is highly import dependent and has remained so over time: local linkages have been largely confined to primary inputs, while manufactured components or intermediate items, technical and consultancy services and technology inputs have continued to be imported. The degree of import dependence has thus been much higher in Africa than it has in most other developing regions.

Import dependence alone would not matter if the transformation of imported inputs took place with sufficient effectiveness to permit growth, diversification and, most important, penetration of foreign markets. However, the weakness of African industry shows itself most clearly in the sphere of manufactured exports. As data collected by the World Bank (1989: Appendix, Table 17) show, the total manufactured exports of Africa were valued at $3.5 billion in 1987. This was under one-tenth the value of the manufactured exports of Hong Kong, South Korea or Taiwan in that year ($44.6 billion, $43.9 billion and $47.3 billion, respectively) and only 55 percent of that of Thailand, a relative newcomer. Africa contributed less than 1 percent to the $371.5 billion in total manufactured exports of the Third World as a whole; in 1973 this share had been nearly four times higher. Furthermore, African exports are predominantly low-technology products: capital goods play only a negligible role.

Part of the poor export performance of African manufacturing is explained by the inward orientation of the regional trade regime. With the sole exception of Mauritius, there is no African economy which is strongly export oriented in the East Asian mode, and even the Mauritian export boom in manufactured products - almost entirely knitwear and other garments - is based on factors which distinguish Mauritius from the rest of Sub-Saharan Africa: a strong indigenous entrepreneurial class and a well-educated if not technically-advanced labour force, as well as a large influx of direct investment from Hong Kong that was stimulated partly by the trade regime and partly by the quality of labour. In other words, a specific interaction of incentives and skills sparked off the Mauritian success. Only one other African country is counted (by WDR 1987) as "moderately" export oriented: Cote d'Ivoire, whose export success has been much more limited and has been

directed mainly to neighbouring French-speaking countries. Moreover, manpower in Cote d'Ivoire has been greatly supplemented by expatriates at all higher levels of management, although this has not been sufficient to launch the country on a course toward becoming an NIC.

The export record of African industry thus reflects an inherent competitive weakness, as well as the weakness of the incentives provided by the trade regime. There are many other anecdotal indicators of these weaknesses. According to the World Bank, the cost of setting up industrial projects tends to be much higher in Africa than it is in other developing regions. Detailed micro-level studies of technical efficiency show very little capability to operate or improve on imported technologies (Mlawa 1983 and Wangwe, forthcoming, on Tanzania, Page 1980 on Ghana, and Mytelka, forthcoming, on Cote d'Ivoire), although where foreign skills are brought in to provide a minimum base and a "teaching" function the situation is much better (Pack 1987 on Kenyan textiles). The tales of woe of mismanaged parastatal entities are too well known to bear repetition here (Nellis 1986).

Most of these features are also found in other developing countries. However, many of those countries have overcome the problems to some extent, while a few have managed so well that they are about to join the ranks of the mature industrialized nations. It is the extent, pervasiveness and duration of the problems that distinguish African industry from industry in Asia or Latin America. The exceptions which undoubtedly exist serve to show that, once certain conditions are met, African industry <u>can</u> match industry in other regions, but that in an overwhelming proportion of cases these conditions are not fulfilled.

IV. AFRICAN INDUSTRIAL PERFORMANCE

The following subsection draws heavily on Lall (1990 and forthcoming).

A Framework for Analysing Industrial Success

There are two widely held views on the reasons for the disappointing results of industrialization in Africa. The view favoured by African governments focuses on the existence of external economic tremors which have led to foreign-exchange shortages and domestic recessions in the region. This explains the falls in production, but does not explain the lack of competitiveness, dynamism and linkages, nor the extreme dualism - the extreme

difference between the traditional and modern areas - of the production sector. The view favoured by the World Bank and by neoclassical development economists focuses on the existence or non-existence of certain policy incentives, including those in trade and industry. It describes poor industrial performance with reference to inward trade policies, public ownership and other interventions on market forces. It explains some of the causes of poor export performance and the lack of competitiveness due to protected domestic markets. However, it places the whole burden on policy rather than on structural factors and so tends to be partial and incomplete. It does not explain, for instance, why other countries which protect domestic markets have managed to develop dynamic industrial sectors while countries in Africa have not been able to do so, or why highly export-oriented NICs such as South Korea and Taiwan have been able to build up a major part of their competitive strength by intervening heavily and protecting selected industries.

A more comprehensive approach to the common denominators in industrial success must be adopted. This approach should be based upon a realistic understanding of the features of economic efficiency within companies and should involve a broader evaluation of industrial performance founded on an extrapolation from those features. Recent research on the acquisition of technological capabilities within firms in developing countries would provide a convenient starting point (Dahlman et al 1987, Lall 1987, Katz 1987, Fransman 1986, Pack and Westphal 1986). The antecedents of this research are to be found in the work of economic historians such as Rosenberg, originators of the "evolutionary theories" of growth such as Nelson and Winter, analysts of technical change such as Freeman and theoreticians dealing with problems of innovation and information such as Arrow. The application of the ideas of these diverse theorists to the problems of developing country enterprises has yielded many interesting new insights.

First, to achieve efficiency even in the static sense of mastery of a given technology can be slow and difficult. The process goes well beyond the mere erection of a physical facility, passive familiarity with the functioning of that facility and the implementation of economies of scale. It often requires that firms launch new activities to develop new skills, search for new sources of information, acquire supplier networks and set up new organizational structures. In developing countries, where skills, information, suppliers and institutions are not on-hand locally, companies must usually invest heavily in the creation of capabilities. There is no predictable

learning curve which all enterprises must follow. The process of becoming efficient is frequently uncertain and risky and often open-ended. Otherwise identical firms may remain at different levels of proficiency depending on the techniques they employ to build capabilities. This is true everywhere, but companies in the developing countries face greater barriers because of the absence of readily available support systems.

Second, efficiency can never be static since inputs, products and the technical environment are always changing. Dynamic efficiency - the talent to adapt, improve and innovate on existing technologies - requires skills which are more mature than those required for simple mastery. Even competence in the selection and effective use of imported technologies calls for considerable talent, and a successful firm has to expand its core capabilities continuously in order to diversify, reduce its dependence on foreign expertise and keep abreast of the latest advances. No enterprise can be self-sufficient. Specialization is essential for success. In certain critical areas, every company must deepen and broaden its capabilities if it is to become fully competitive.

Third, because of competition, the creation of new skills is extremely market sensitive. Competition provides the basic spur to investment in the development of skills, but this is a double-edged sword. Too little competition may lead to inadequate or misguided capacity building, too much may wipe out those firms which cannot finance the acquisition of new capabilities. A model set of policy incentives would thus combine some competition (of the right sort, ideally from foreign markets) with protection during the period of learning when costs are high and quality low. Of course, the protection should be geared to the complexity of the activity, and its duration should be limited, otherwise the competitive stimulus is lost. Greater protection is necessarily required for more difficult activities, but only if it is combined with inducements to enter export markets or face domestic competition in the near future, as the experience of South Korea, Taiwan and other NICs shows.

Fourth, policy incentives are only part of the story. The ability of firms to benefit from inducements depends on their access to skills, but it also depends on the existence of infrastructures, supplier networks and institutions that allow information and technology to flow, adequate standards to be set, research to be conducted, finance to be provided and labour to be trained. In other words, in-house capacity acquisition has to be complemented by the external educational and training system, the development of suppliers and services and an institutional framework which allows markets to function

efficiently. In developed countries these requirements are taken for granted; in developing countries they cannot be. Thus, protection is only part of the policy package needed: it has to be accompanied by measures to improve skills, institutions and specializations.

These common denominators of the success of individual firms can be projected to the national level. Assuming that macroeconomic conditions and physical infrastructures are appropriate, industrial development depends on the complex interplay of three sets of factors: policy incentives, capabilities and institutions (Lall 1990 and forthcoming). One set by itself may foster industrialization, but without the other two it will not lead to the kind of dynamic progress registered, for example, by the East Asian NICs.

The policy incentives comprise both enough selective protection to permit capacity diversification and enhancement and the prescriptions espoused by Balassa, Bhagwati and Krueger, such as export-market orientation (strictly speaking, "neutral" incentives to sell in foreign and domestic markets) and domestic competition. The standard neoclassical recipe makes some allowances so that infant-industry protection may coexist with an orientation toward export markets. However, to minimize "distortions", it recommends only low-level, uniform and short-lived protection across the board. There is neither theoretical, nor empirical support for such a recipe. Once the possibility of business failures due to dynamic and unpredictable skill needs, externalities and complementarities is admitted, then it must be realized that protection has to vary according to activity. If judiciously administered, moreover, such selective protection is a necessary element of industrial enhancement (Pack and Westphal 1986, Lall forthcoming). The key is, of course, the words "judiciously administered": haphazard, absolute and permanent protection which does not give enterprises the promotional assistance they require to build competitiveness is a recipe for stagnation, not success. This is the experience of the majority of industrializing countries, and it supports the case for caution and selectivity.

Three capabilities are essential in the development process: the ability to establish physical capacity, the ability to provide skilled manpower and the ability to tap technology.

The installation of physical capacity is an obvious factor in industrial growth. Yet, it should be pointed out that investment in physical capacity is a skill which is not equally shared. Thus, different countries could invest similar amounts of time, money and effort in the expansion of physical

capacity, and the results would be very different in terms of costs, the technologies involved, sophistication, design and the like.

Skilled manpower is provided through formal educational systems and employee training programmes undertaken by industry (King 1984). The relevance of education and training for development is also obvious. Nonetheless, specialized technical training tends to be overlooked in many discussions on industrialization. Although this high-level training is always required, general education and the overall flexibility of the workforce are more important during the early stages of industrial development. The need for advanced training rises sharply only as more complex industries are set up. In our world of rapid innovation, a broad base of scientific and engineering skills becomes imperative for success as countries progress beyond the simplest industrial activities.

Physical capacity and skilled and well-trained manpower must be combined with the proper technological environment. The ability to tap technology is required in order to absorb, adapt and improve on new knowledge. While innovation is accepted as the lifeblood of industrial progress in developed countries, the need for more mundane efforts in technology, especially in developing countries, tends to be overlooked. Yet such efforts will determine how successful newcomers to the industrial scene are in producing efficiently and in establishing dynamic and competitive advantages.

Finally, in the industrial context, institutions - entities which facilitate the functioning of markets - can provide finance, information, services, standards, export assistance: the whole network of external linkages that allows individual firms to operate efficiently. This network is not created automatically on the open market, and many institutions may have to be established by the state to remedy market weaknesses, especially in the areas of science, technology, education and infrastructure.

Let us now apply this general framework so as to understand where the structural weaknesses lie in the case of Africa.

Evidence on the NICs strongly supports the contention that their industrial performance has depended not on export orientation alone, but on export orientation combined with selective protection and interventions to enhance capabilities and institutions (Lall 1990). Some of this evidence is presented in summary form below in order to clarify the situation in Africa.

Policy Incentives, Capabilities and Institutions in Africa

Policy Incentives. The framework sketched out here does not dismiss the role of appropriate policy incentives in the industrialization process. On the contrary, an export-oriented trade regime is taken to be superior to a regime based on import substitution not only because it permits specialization and more rapid growth in exports, but also because it fosters a healthier and more rapid accumulation of industrial skills and capabilities. However, "appropriate" incentives do include the protection, possibly selective and variable, of infant industries. Business failures mean that open-market prices are not providing correct signals for long-term investment or dynamic comparative advantage. In the case of South Korea (Pack and Westphal 1986), selective protection, often high-level and prolonged, has been necessary for the strategy of rapid industrial enhancement led by nationally owned enterprises.

This kind of intervention, with the emphasis on selectivity and quick gains in competitiveness, should be sharply distinguished from the indiscriminate, permanent and by now "classic" protection established in most developing countries. That kind of protection places no premium on gains in efficiency, ignores global market conditions, tends to ignore the other components of industrial capacity building and often also stifles market forces within an economy. As the case of India illustrates (Lall 1987), the result can often be technological gaps, stagnation and inefficiency.

The interventions of policy incentive regimes in Africa have, sadly, overwhelmingly involved the latter sort of protection (Steel and Evans 1984). The results have been worse in Africa than they have been in India because of smaller, more fragmented markets, less technical skill and technological growth, and greater shortages of business talent, exacerbated by the leading role assigned to parastatal entities. However, in those African countries with more mature local capabilities or access to foreign expertise, the results have been promising. Thus, during the years of isolation under the Unilateral Declaration of Independence, an impressive and reasonably functional structure for capital- and intermediate-goods production was set up in Zimbabwe. ZISCO, the country's integrated iron and steel mill, was the only plant of its kind in Sub-Saharan Africa to achieve an acceptable standard of efficiency although it was state owned and highly protected. Similarly, we have remarked on the ability of Mauritian enterprises, aided by investments from East Asia, to erect garment factories which could take advantage of liberal export policies. The technology involved was relatively simple, but the production and the

marketing of the products required skills and initiative unavailable in many other African countries. The textile industry in Kenya has also achieved a respectable degree of technological proficiency through the substantial and prolonged infusion of know-how by experienced technicians from India (Pack 1987).

In general, however, policy incentives in Africa have not favoured healthy industrial development (see Meier and Steel 1989, World Bank 1989). The negative effects of inward-oriented regimes and the predominance of parastatal entities in local initiatives have been exacerbated by widespread price controls, restraints on local competition by cumbersome licensing systems, endemic corruption and financial repression. In some countries, political considerations have put a check on efforts by significant non-African settler groups.

What would be the response of Africa to more liberal incentives? In manufacturing, apart from areas of obvious comparative advantage such as the processing of local mineral and agricultural resources, do sufficient skills exist to permit a spurt of export-oriented growth? In the long term, what will determine the dynamic comparative advantage of Africa? The answers to these questions depend on the human resources and institutions of the region.

Capabilities. Let us start with the ability to increase physical capacity. In a large number of African countries, the expansion of physical capacity has been blocked by the effect on local economies of shocks in global markets and macroeconomic and financial mismanagement, and the poor state of infrastructure has been further weakened by recent neglect and underinvestment. However, even if these factors could be corrected, significant problems within the industrial sector would remain. These problems arise from the lack of skills in Africa - the skills needed to identify and evaluate projects, to specify feasible economies of scale and product and input mixes, to choose, purchase and transfer appropriate technologies, to carry out, monitor and participate in basic and applied project engineering, to select, buy, check and install equipment, to provide the necessary public-sector support, to commission plants and to execute start-up and training functions.

The efficient implementation of industrial initiatives thus requires a broad spectrum of technical and organizational skills. Many of these skills can be brought in through specialized engineering firms, consultants or capital goods manufacturers in developed countries. However, the price of relying on foreign contractors can be high, and certain critical functions, such as initial project preparation, negotiations for the design and transfer

of technology, engineering, management and the selection of equipment, should be handled at least partly by local project sponsors. Otherwise, there is the risk of bias in the choice of technologies and the design and siting of projects. The problems caused by inappropriate technologies (Stewart 1977) and "white elephants" in Africa are as well known as are the very high costs of setting up projects (a steel mill is three to four times more expensive to build in Nigeria than it would be anywhere else). What is perhaps less widely appreciated is that the lack of local participation in design has led to failures in the mastery, adaptation and improvement of imported technologies and to an absence of linkages with potential domestic suppliers. Thus, valuable opportunities for technological progress and spinoffs have been lost in Africa, unlike in the NICs, where costs are much lower and many externalities have been accrued.

Let us now consider the ability to provide skilled manpower in a more general sense. A significant portion of the entrepreneurs, technicians and managers required for industrialization have gotten their experience in commerce and industry. In comparison with other developing regions, Africa has been particularly unfortunate in this area. With the exception of a few trading communities, the indigenous populations of most of Africa have had little contact with modern commerce or manufacturing. There is no shortage of business drive: the informal sector is as active and vibrant in Africa as it is in other developing regions (Page 1979), and the recent recession has swelled the ranks of informal business people. Nonetheless, the ability to profit from opportunity is not per se the same as the entrepreneurial ability needed to create and run modern industries, which require larger economies of scale, longer lead times, more advanced technologies and more complex organizations than do traditional craft or informal sector activities (Kilby 1971).

There tends to be a progression in most developing societies from commerce and informal industry to formal small- and medium-scale manufacturing and, within manufacturing, from smaller and simpler to larger and more complex activities. There is, in other words, a learning process in the acquisition of entrepreneurial skills just as there is in the acquisition of technological or managerial skills. Shaped by colonial rule, the structures inherited by many African economies have, with few exceptions, placed those economies far down on the learning curve. The attempt to force the pace through "Africanization" - schemes for the promotion of state-run enterprises or small-scale industries - has not been able to by-pass the learning process. Some learning has certainly occurred: in general, because of less direct

colonial presence in the past, West Africa has a more mature business class than do Eastern and Southern Africa, and some communities possess more advanced trading skills than do others. But, by and large, the inheritance of capabilities has been too limited to have yet permitted the emergence of a dynamic African industrial class (Navaretti forthcoming). The small-scale formal sector is still very weak and underdeveloped (Page 1979).

Experience is a source of capability acquisition; education and training together are another, more important one. The relationships between education and industrialization are significant and binding, but the precise links between particular types of education and specific levels or forms of industrialization are not always easy to trace (King 1984). As noted earlier, the operation of simple low-technology activities with which industrialization generally starts requires literacy and schooling, a range of basic technical skills and some high-level technological and managerial talents. To build up a foundation of simple activities and then initiate more demanding ones calls for increasingly advanced levels of and technical specializations in education. How do the structures and achievements of African education compare with those of other regions?

Table II sets out aggregate data on gross enrolments in Africa and other developing regions in 1965 and 1985. Next, Table III provides a more detailed breakdown for a large sample of African countries (and some others for comparison); it also shows figures for adult literacy rates and the educational attainment of the population over age 25.

TABLE II: GROSS ENROLMENT RATIOS IN EDUCATION
(% Of Age Group)

	Primary		Secondary		Tertiary	
	1965	1986	1965	1986	1965	1986
Sub-Saharan Africa	41	66	4	16	0	2
East Asia	88	123	23	45	1	5
South Asia	68	84	24	32	4	5
Latin America	98	108	19	48	4	20
All developing countries	88	106	21	52	5	18

Source: World Bank: World Development Report 1989, Table 29.

TABLE III: EDUCATIONAL ATTAINMENT IN SUB-SAHARAN AFRICA

	Enrolments as % of Age Group						Adult Literacy Rate	Education of Population Over 25 (As % of Total Age Group)					Tertiary-level Students Per 100,000
	Primary		Secondary		Tertiary		(Latest)	Year	No School	Entry Primary	Entry Secondary	Post Secondary	Population (Year)
	1965	1985	1965	1985	1965	1985							
Low-income countries													
Benin	34	65	3	20	0	2.0	25.9	1979	89.2	8.3	1.4	0.3	179 (1984)
Burkina Faso	12	32	1	5	0	0.6	13.2						57 (1984)
Burundi	26	33	1	4	0	1.0	33.8						59 (1985)
Central African Republic	56	73	2	13	0	1.2	40.2						103 (1985)
Ethiopia	11	36	2	12	0	0.5	55.2						63 (1985)
Ghana	69	66	13	39	0	1.5	53.2	1970	77.7	5.8	12.8	0.4	125 (1986)
Kenya	54	94	4	20	0	0.9	59.2	1979	58.6	32.2	7.9	N/A	106 (1985)
Lesotho	94	115	4	22	0	2.2	73.6	1976	34.3	52.0	4.6	0.1	158 (1984)
Madagascar	65	121	8	36	1	5.0	67.5						383 (1985)
Malawi	44	62	2	4	0	1.0	41.2	1977	55.4	37.3	1.5	0.2	59 (1986)
Mali	24	23	4	7	0	1.0	16.8	1976	95.4	3.0	0.6	0.2	81 (1986)
Mauritania	13	37 a/	1	12 a/	..	0.4 a/	17.4						248 (1986)
Mozambique	37	84	3	7	0	0.1	38.0	1980	61.5	35.9	0.5	0.1	10 (1986)
Niger	11	28	1	6	0	0.5	13.9	1977	88.5	10.3	1.0	0.1	48 (1984)
Rwanda	53	64	2	2	0	0.3	46.6	1978	77.0	16.8	2.0	0.3	33 (1985)
Senegal	40	55	7	13	0.5	2.2	28.1	1970	95.3	N/A	2.1	0.1	209 (1985)
Sierra Leone	29	54 a/	5	15 a/	0	0.6	29.3						55 (1980)
Somalia	10	25	2	17	0	0.6	11.6						72 (1980)
Sudan	29	49	4	19	0.4	2.1 a/	N/A						173 (1985)
Tanzania	32	72	2	3	0	0.4	46.3	1978	48.6	40.7	1.6	0.2	26 (1985)
Togo	55	95	5	21	0	2.0	40.7	1981	76.5	13.5	8.5	1.3	156 (1984)
Uganda	67	57 a/	4	18 a/	0	1.0	57.3						65 (1985)
Zaire	70	98	5	57	0	2.0	61.2						137 (1985)
Zambia	53	103	7	19	..	1.6 a/	75.7	1980	49.8	37.0	12.8	0.4	128 (1986)
Middle-income countries													
Botswana	65	104	3	29	0	1.0	70.8	1981	54.7	3.1	3.1	0.5	175 (1986)
Cameroon	94	107	5	23	0	2.0	56.2	1976	71.3	24.0	4.4	0.3	185 (1984)
Cote d'Ivoire	60	78	6	20	0	3.0	42.7						208 (1985)
Gabon	134	123	11	25	..	4.0	61.6						290 (1984)
Liberia	41	70 a/	5	21 a/	.5	2.1	35.0	1974	87.1	2.6	3.6	1.5	203 (1980)
Mauritius	101	106	26	51	3	1.0	82.8	1983	32.4	48.1	17.5	1.9	119 (1986)
Nigeria	32	92	5	29	0.2	3.0	42.4						239 (1984)
Zimbabwe	110	131	6	43	0	2.6	74.0						330 (1986)
Sub-Saharan Africa (1986)	41	66	4	16	0	2.0	41.8	1985b/	49.0	40.0	10.0	1.0	
Other developing countries													
Brazil	108	104	16	35	2.0	11.0	76.0	1980	32.9	50.4	6.9	5.0	1,140 (1984)
Hong Kong	103	105	29	69	5.0	13.0	83.0	1981	22.5	16.7	13.2	7.1	1,410 (1984)
South Korea	101	96	35	94	6.0	32.0	93.0	1980	19.7	34.5	18.2	8.9	3,606 (1986)
Thailand	78	97	14	30	2.0	20.0	86.0	1980	20.5	67.3	4.5	2.9	1,998 (1985)

ource: UNESCO (1989), World Bank (1988) and World Development Report 1989, McMahon (1987).

/ 1982-1983.
/ Figures for all of Sub-Saharan Africa refer to the labour force and so may apply to a portion of the total population hat is smaller than the portion referred to for individual countries.

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The data show that Africa started without advanced students, but that it has made considerable progress in enrolling pupils at all levels. However, enrolment, literacy and educational attainment still lag far behind those of other developing regions. The most critical input for industrial development - secondary education - is particularly backward, and the gap in tertiary education is even greater. Basic literacy in all of Africa was only 5 percent of that in South Korea, the "model NIC", while the comparative figures for secondary and tertiary enrolment were 17 percent and 6 percent, respectively. Nearly half of the African labour force in 1985 had had no schooling whatsoever, compared to only 20 percent in South Korea (1980). University enrolments per 100,000 population came to 383 (the highest in Africa) in Madagascar (1985), 330 in Zimbabwe (1986) and only 10 in Mozambique (1986), compared to 3,606 in South Korea (1986). In terms of literacy and secondary-school enrolments, the best education by far was offered by Mauritius, which thus provided the skill base for its export success.

Figures for gross enrolments are misleading because they do not show the proportion of students who stay on to complete courses. Dropout rates in Africa tend to be particularly high (World Bank 1988), especially in comparison with East Asia. The figures also do not show the quality of the education provided, nor the technical orientation of courses. There are reasons to believe that educational quality in Africa has been declining recently (ibidem), and that the quality of vocational training is lower in Africa than it is in other developing regions (Middleton and Demsky 1989).

Let us look at the available data on technical training at tertiary levels (Table IV) and vocational training (Table V). The total number of tertiary students enrolled in scientific and technical fields in Africa came to 175,000 in about 1983, below half of similar enrolments in Thailand (1985), below 30 percent of those in South Korea (1987), and only five times those in the tiny island economy of Hong Kong (1984). As a percentage of the population, Africa had 0.04 percent in general science, compared to 0.7 percent in Thailand, 1.1 percent in Hong Kong and 1.5 percent in South Korea. No African country had a proportion higher than 0.17 percent (Madagascar in 1985). Of the more industrialized countries in Africa, Nigeria (1980) and Zimbabwe (1986) had 0.02 percent, Cameroon (1980), Mauritius (1986) and Zambia (1985), 0.03 percent, and Cote d'Ivoire (1985) and Kenya (1985), 0.06 percent.

Data on narrower technical fields are even more directly relevant to industrial skills. In engineering, for example, total enrolments in Africa came to 48,000, slightly more than twice those of Hong Kong and only 21 percent of those in South Korea. As a proportion of the population,

TABLE IV: TERTIARY LEVEL STUDENTS IN TECHNICAL FIELDS
(Totals And % Of Population)

Country (Year)		General Science a/		Science & Technology b/		Engineering	
Low-income countries							
Benin	(1980)	1,625	0.04	1,286	0.03	243	0.006
Burkina Faso	(1985)	944	0.014	356	0.005	0	...
Burundi	(1985)	4,915	0.102	332	0.007	125	0.003
C. African Rep.	(1986)	299	0.01	105	0.004	51	0.002
Ethiopia	(1985)	11,314	0.025	5,879	0.013	1,728	0.004
Ghana	(1983)	5,934	0.048	3,741	0.030	1,200	0.01
Kenya	(1985)	12,226	0.06	4,762	0.022	3,325	0.016
Lesotho	(1985)	220	0.014	207	0.013	0	...
Madagascar	(1985)	18,098	0.17	11,896	0.115	2,349	0.023
Malawi	(1985)	946	0.013	416	0.006	221	0.003
Mali	(1985)	2,601	0.03	858	0.01	858	0.01
Mauritania		N/A		N/A		N/A	
Mozambique	(1985)	1,093	0.008	610	0.004	541	0.004
Niger	(1985)	657	0.01	446	0.007	...	...
Rwanda	(1985)	744	0.012	459	0.007	95	0.002
Senegal	(1985)	5,299	0.08	2,555	0.03	207	0.003
Sierra Leone		N/A		N/A		N/A	
Somalia	(1986)	4,055	0.084	1,822	0.038	835	0.017
Sudan	(1985)	8,912	0.04	3,719	0.017	2,448	0.01
Tanzania	(1985)	1,883	0.008	917	0.004	670	0.003
Togo	(1985)	1,369	0.04	751	0.025	149	0.005
Uganda	(1985)	3,345	0.021	1,190	0.007	256	0.002
Zaire	(1985)	15,492	0.05	2,718	0.009	795	0.003
Zambia	(1985)	1,827	0.026	1,234	0.018	544	0.008
Middle-income countries							
Angola	(1985)	1,716	0.019	1,444	0.016	722	0.008
Botswana	(1986)	195	0.018	195	0.018	0	...
Cameroon	(1980)	3,227	0.03	2,085	0.02	373	0.004
Cote d'Ivoire	(1985)	6,344	0.062	2,574	0.025	365	0.004
Gabon	(1986)	1,157	0.096	557	0.046	188	0.016
Liberia	(1980)	1,252	0.06	748	0.034	68	0.003
Mauritius	(1986)	299	0.03	138	0.01	87	0.01
Nigeria	(1980)	18,746	0.02	14,842	0.015	4,974	0.005
Zimbabwe	(1986)	1,713	0.02	888	0.01	389	0.005
Sub-Saharan Africa	(±1983)	174,800	0.043	96,100	0.02	48,100	0.01
Other developing countries							
Brazil	(1983)	534,600	0.4	323,300	0.24	164,600	0.13
Hong Kong	(1984)	35,500	1.06	27,500	0.51	21,100	0.41
South Korea	(1987)	585,400	1.46	320,600	0.76	227,600	0.54
Thailand	(1985)	360,000	0.7	N/A		N/A	

Source: UNESCO (1989), World Bank (1988).

a/ Agriculture, architecture, forestry, medicine, pisciculture, trades and crafts, transport and communications, plus the following.
b/ Computer science, engineering, mathematics and the natural sciences.

TABLE V: ENROLMENTS IN SECONDARY EDUCATION

Country	1975 Number	Latest Year Number (Year)	As % of population
Angola	2,712	3,561 (1984)	0.04
Benin	1,151	6,358 (1986)	0.16
Botswana	1,699	2,430 (1986)	0.22
Burkina Faso	2,669	4,295 (1986)	0.06
Burundi	1,099	5,551 (1986)	0.12
Cameroon	36,262	86,468 (1984)	0.83
Central African Republic	1,922	2,060 (1986)	0.08
Cote d'Ivoire	23,076	18,993 (1984)	0.19
Ethiopia	6,020 a/	4,969 (1985)	0.01
Gabon	2,450	7,850 (1984)	0.65
Ghana	18,319	16,367 (1985)	0.12
Kenya	5,468	7,840 (1985)	0.04
Lesotho	547	1,168 (1984)	0.07
Liberia	851	2,322 (1980)	0.10
Madagascar	2,412	9,204 (1984)	0.09
Malawi	529	25,177 (1985)	0.34
Mali	5,008	6,691 (1984)	0.08
Mauritania	1,004 b/	2,002 (1986)	0.10
Mauritius	1,032	962 (1986)	0.10
Mozambique	9,401 a/	10,485 (1986)	0.07
Niger	233	615 (1985)	0.01
Nigeria	26,241	87,846 (1983)	0.09
Rwanda	1,790	5,351 (1986)	0.08
Senegal	8,182	8,770 (1985)	0.13
Sierra Leone	799	N/A	N/A
Somalia	1,824	7,154 (1985)	0.15
Sudan	8,996	25,610 (1985)	0.12
Tanzania	1,360 a/	1,550 (1986)	0.01
Togo	5,118	5,688 (1986)	0.19
Uganda	3,296	4,181 (1982)	0.03
Zaire	54,905	215,190 (1983)	0.69
Zambia	2,377	2,316 (1982)	0.03
Zimbabwe	1,312	331 (1983)	....
Sub-Saharan Africa	233,700 c/	667,100 (1983)	0.16
Other developing countries			
Brazil	782,502	1,480,997 (1985)	1.10
Hong Kong	21,509	31,688 (1984)	0.59
South Korea	436,538	837,369 (1984)	2.07
Thailand	191,066	298,000 (1984)	0.58

Source: UNESCO (1989), World Bank (1988).

a/ 1981; b/ 1980; c/ 1970.

engineering enrolments were 0.01 percent in Africa, 0.41 percent in Hong Kong and 0.54 percent in South Korea. The highest proportion in any African country, again in Madagascar, was 0.02 percent, followed by 0.016 percent in both Gabon and Kenya.

The United Nations Educational and Scientific Organization (UNESCO) collects data on the number of "potential scientists and engineers" in each region. Rough as the data are, they again indicate the small size of the human-resource base available for industrialization in Africa. In 1985, Africa had 1,376 potential scientists and engineers per million population, compared to 11,730 in Asia, including Japan, 11,759 in Latin America and 8,263 in all developing countries.

In vocational training, we find that total enrolment in the region stood at 667,100 in 1983 (World Bank 1988). This was 80 percent of the enrolments in South Korea in 1984. As a proportion of the population, the figures were 0.16 percent in Africa, about 0.6 percent in Hong Kong and Thailand, 1.1 percent in Brazil and 2.07 percent in South Korea. The highest percentage enrolments in Africa were registered in Cameroon, Gabon, Malawi and Zaire: most of the more important industrializing countries lagged behind in training workers in basic technical skills.

While some of these data may not be precise or strictly comparable, the broad implications are clear: "The educational structure of Sub-Saharan Africa is unsuitable for industrialization" (McMahon 1987: page 19). If the data had been adjusted by taking into account training within firms and the quality of education in general, it is likely that the figures would show Africa even further behind the NICs of East Asia. If Africa is to emulate the dynamic growth and diversification of those countries, there will have to be a spectacular rise in the quantity and the quality of the fruits of the areas of education relevant to industrialization in the region. A concentration on exports alone will not be directly beneficial in this, but it would foster more positive exploitation of existing comparative advantages and so lead to higher incomes and, subsequently, a relaxation of the resource constraints on education. Nonetheless, the ability of Africa to respond to the resulting incentives would remain limited for a long time.

The lack of human resources for industrialization in Africa suggests the generally sorry picture of technological competence and dynamism in the region. There are exceptions, but they are founded precisely on efforts to train manpower within companies. In any case, such efforts have not been widespread, nor have they been intensive enough to make up for the general scarcity of skills. Companies are always reluctant to invest heavily in

training when they might lose their investment through the "leakage" of manpower to competing firms. To compensate for this classic failure of the market, economists recommend the remedy of special subsidies or government sponsorship for training. In Africa, such interventions do exist, but they are not sufficient to ensure training within firms that is comparable to what has been undertaken, say, in South Korea, where 5 to 6 percent of turnover is spent on training (McMahon 1987).

Training within companies is not, of course, a substitute for a system of education but a complement to it. If the educational system does not provide a literate and educated workforce, firms cannot create the capabilities needed for industry. In consequence, because of the shortage of trained manpower, industry in Africa is forced to rely on a small number of skilled personnel that is spread very thin. It is something of a paradox, furthermore, that industry in many African countries is making do with inadequately trained staff, while engineers are out of work, and technically qualified personnel are employed in non-technical occupations (Bennell 1984). This powerlessness to exploit the potential of existing skills itself reflects the low level of managerial competence and the lack of competitive pressures in most African economies. To some extent, it also reflects the tendency of technical personnel to avoid "dirty" production jobs and take up "easier" administrative tasks (ibidem).

Let us consider the third component of capability: the capacity to tap technology. No enterprise, not even one endowed with trained manpower, can achieve efficiency unless it undertakes a conscious, directed effort to collect and assimilate new technical knowledge (Lall 1987, 1990). To measure this kind of effort in routine production or service activities is very difficult; the best available indicator is the proportion of engineers and technicians in the workforce, but this is a crude proxy. In any case, the evidence suggests that relatively little is being undertaken in this area in most African countries. The largest repositories of know-how are probably long-established firms with strong technical links abroad, e.g. the affiliates of multinationals, or local enterprises with foreign management and technical personnel.

An indicator of the effort to tap technology that is relatively easy to measure is formal research and development. Although R & D is likely to be a small part of what is needed in most developing countries to assimilate foreign technologies, it is an increasingly critical input: as more complex technologies are imported and as older technologies are fully mastered, local R & D becomes essential in the adaptation of these technologies (see Cohen and

Levinthal 1989). Without investments in R & D, a manufacturer remains highly dependent on expensive foreign know-how. Even more important, he is thus unable to gain a useful understanding of the principles behind the technologies he has acquired and build upon those principles to tailor the technologies to his needs and develop new products and processes. It is accepted in the literature on technology that an increase of investments in R & D is a fundamental feature of industrial development even in countries which depend on imports for major innovations.

Data on R & D in Africa are patchy. Table VI shows data available through UNESCO (1989). They cover research in agriculture and other non-industrial sectors. It is likely that much of the R & D carried out in the region is not devoted to manufacturing. The UNESCO data on four African countries - Congo, Malawi, Mauritius and Zambia - indicate that agriculture, mining, public utilities and construction accounted for all the spending and the employment of scientists and engineers in the R & D undertaken in the production sector. There was no R & D registered in manufacturing in these countries. No other African countries were included in the tabulations. Moreover, the data do not distinguish between the R & D conducted by manufacturing enterprises and that conducted in state-run laboratories for non-industrial purposes. Normally, R & D in the latter is much less relevant to industrial productivity than is that in the former. On the basis of impressionistic evidence from East Africa, R & D within firms appears in fact to be very rare in the region and, when it does exist, seems to be extremely limited and usually confined to the solution of problems in quality control and production engineering.

In any case, the data show that total R & D levels are generally low in Africa (some of the figures, such as those for Togo, are somewhat suspect). The number of scientists and engineers involved in R & D is also low, although Ghana, Mauritius and Sudan stand out as exceptions when population percentages are taken into consideration (the numbers then exceed those for Thailand and approach those for Brazil). The regional average - 49 scientists and engineers in R & D per million population - is well below the overall average for developing countries (127) and less than 4 percent of the numbers in South Korea and Taiwan.

Given the early stage of industrial development in Africa, the small quantity of formal initiatives in modern technology areas should not be surprising, nor is it entirely inappropriate. Even a booming export-oriented economy such as that of Thailand has managed well until now by relying passively on imported technology for most industrial needs. It is over the

TABLE VI: R & D IN SAMPLE AFRICAN COUNTRIES

Country (Year)		R & D As % of GNP	Scientists and Engineers in R & D Per million inhabitants	Total
Low-income countries				
Burkina Faso	(1975)	0.5	N/A	N/A
Burundi	(1984)	0.4	47	218
C. African Rep.	(1984)	0.2	78	196
Ghana	(1980)	0.9	349	4,084
Kenya	(1975)	0.8	26	361
Madagascar	(1980)	0.2	13	112
Malawi	(1975)	0.2	37	189
Niger	(1975)	0.1	19	122
Rwanda	(1985)	0.1	12	71
Senegal	(1975)	1.0	106	700
Sudan	(1980)	0.2	203	3,806
Togo	(1980)	1.4	132	329
Zambia	(1976)	0.5	56	250
Middle-income countries				
Botswana	(1975)	0.2	37	41
Cameroon	(1976)	0.6	49	500
Cote d'Ivoire	(1975)	0.3	72	502
Mauritius	(1986)	0.3	305	305
Nigeria	(1980)	0.3	26	2,200
Sub-Saharan Africa	(1980)	0.36	49	16,387
Other developing countries				
Brazil	(1982)	0.7	256	100,100
South Korea	(1987)	2.3	1,283	54,000
Taiwan	(1986)	1.1	1,426	27,000
Thailand	(1985)	0.3	150	6,500

Source: UNESCO (1989).

long term, as the industrial infrastructure grows in importance, that R & D becomes a significant factor in competitiveness. More relevant to Africa now is the development of skills and the wielding of technology in production. This is where countries such as Thailand, and the East Asian NICs a decade or two earlier, have established a distinct lead.

Institutions. Entities and services which facilitate the smooth functioning of markets and the creation of skills are central to a broad-based process of industrialization. Firms cannot operate efficiently as isolated units. They must establish a variety of strong linkages with the rest of the economy; the economy, in turn, must provide a variety of

information, inputs, services and infrastructures, as well as standards and rules, to enable firms to produce, invest and grow. The primitive market networks which form the initial foundation for industrialization in developing countries can furnish these linkages and services only with great difficulty. Some deficiencies can be remedied by individuals or groups in response to market forces; others require direct government intervention, and still others call for the creation of permanent institutions which are independent, specialized and accountable to markets.

Successful NICs have been assiduous in the systematic creation of institutions to enhance or control market forces. For instance, they have set up institutions in the areas of industrial standards, testing, exportation, quality control, design, training, technology-information systems, research and technical-extension services. Without this superstructure, the overall dynamism and depth of industrial development in these countries would have been greatly curtailed, especially in the larger countries where the implementation of complex market linkages and aggressive technology-development strategies has been essential.

Relevant institutions are certainly to be found in Africa, but the general scarcity of trained manpower has held back proper institutional development. Limited support is provided to manufacturers in terms of technical services, training, information and standards. Linkages between large and small firms are minimal and are not facilitated by appropriate institutional assistance to small suppliers and subcontractors. Where institutions exist, they are often poorly staffed and managed, given conflicting objectives and starved of funds. Inward market orientation and government economic intervention reduce incentives for the private sector to find institutional solutions of its own.

Industrial development appears to be beset in Africa by a pattern of negative interaction among policy incentives, capabilities and institutions that has held back growth and, in some cases, led to a vicious spiral of decline. The region has a rich supply of natural resources and primary export products, but only a tiny core of industrial skills. It has built up physical capacity too quickly for its capabilities, institutions and infrastructures to cope. The industries which have been set up have been highly protected, tightly controlled and, in many cases, run by incompetent public-sector organizations. The stock of skills and technical knowledge needed to manage these industries has grown, but not rapidly enough to lead to substantial gains in efficiency; the expansion of educational and training systems has been inadequate, and on-the-job training has been compromised by faulty

incentive regimes. All this has occurred while technologies have been changing at lightning speed in the rest of the world, and the "easy" niches in manufacturing and trade have been filled by the NICs. Africa has progressively fallen behind in trade and industrial development.

The region has been afflicted by crises in global markets and inappropriate macroeconomic policies that have further slowed growth and deprived industry of the foreign exchange needed to sustain production. Adjustment programmes and recession have eaten away especially at expenditures in education and health care, damaging the fragile human-resource base on which long-term industrial progress depends. The countries which have done relatively well are those which have had a basket of primary products for export, pursued conservative macroeconomic policies and drawn liberally on foreign management skills. However, with the exception of Mauritius, even these countries have failed to adopt the incentives and the educational systems needed to mount sustainable export-oriented industries. Nonetheless, the structural failures (in terms of capacities and institutions) have outweighed the incentive failures in Africa.

In general, neither African governments, nor foreign-aid donors and economic analysts have focused on the structural weaknesses in African industry that have arisen because of deficiencies in capabilities and institutions. Yet, it is the deficiencies in these areas that lie at the root of the problems in industrialization in Africa. The implications of this fact must be addressed directly by policies in Africa and by the programmes of aid donors, who control a crucial portion of the lifeline of foreign exchange flowing into Africa and so exercise a strong policy influence.

V. THE POLICY IMPLICATIONS FOR AID DONORS AND FOR AFRICA

Policy-makers must address the entire spectrum of factors influencing industrial performance if they wish to broaden, deepen and improve the production sector. The small size, remoteness and fragmented character of local markets in Africa place severe constraints on what can be achieved. While these constraints may be lessened through regional integration, each country should already begin to confront them by seeking to optimize industrial development. The strategies available are bound to differ according to differing situations, but each country can act in some fashion to improve conditions in the three main areas described above.

Let us start with policy incentives. It is generally agreed that trade and industrial policies in Africa have been too inward looking, interventionist and oblivious to the importance of efficiency. They have permitted too many "white elephants" to come into existence and obstructed potentially competitive activities. Ownership patterns have been altered to promote Africanization, but at rates which are not economically viable. Loss-making enterprises have been kept in operation too long. Impediments placed on domestic competition and growth have added to the constraints imposed by high levels of indiscriminate protection.

While the correct policy response in most African countries would involve a liberalization of the competitive environment, freer entry for potential investors and incentives which are more neutral in the tug-of-war between domestic and foreign markets, this does not amount to a case for free trade or even for discrete, uniform rates of infant-industry protection. Given the important costs and the long time-frame inherent in any effort to create skills in new, complex industrial activities, and given the differences among technologies, there are no grounds for the argument that all industries should be protected equally, or that all countries should pursue similar policies. More difficult technologies call for more protection, and activities which require more "networking" call for broader protection to embrace related industries (i.e. "strategic" industry groups) where learning is also taking place. Similarly, activities which require more externalities need more support so that investors can benefit and are thus encouraged. The ideal extent of protection also differs from country to country. The lower the level of development, the greater the cost disadvantages suffered by new industries and the wider the extent of protection needed. Thus, a good theoretical and empirical case can be made for tinkering with market-driven incentives in order to foster competitiveness, especially in more difficult industries. Without this intervention, comparative advantage may remain static.

The arguments against such selective intervention are well known. In essence, they can be reduced to three: (1) governments may be no better and, in practice, can be much worse than markets in "picking winners"; (2) the costs of initiating new activities should be borne by capital markets, which should be tackled directly if they function imperfectly, while other arguments for protection (the dynamic and unpredictable "learning curve", externalities, complementarities, etc.) are trivial, and (3), if a selective intervention goes wrong, it can be rectified only with difficulty because vested interests join hands to safeguard loss-making enterprises.

There is clearly some merit in these arguments. Many governments have been notoriously bad in picking winners and staunch in safeguarding "losers". Capital markets do need to be improved, and the financing of risky ventures freed from controls (World Bank 1989). Nevertheless, these arguments can be carried too far. The problem with intervention in the past has not been selectivity, but rather the lack of a strategy of selection based on experience and the proper analysis of economic forces. A policy of wholesale import substitution is hardly sensitive to the need to achieve international competitiveness. By contrast, intervention in South Korea, for example, has focused on only a few activities at a time, encouraged market discipline by balancing export orientation and domestic protection and been combined with a close supervision of the resulting process of growth that has included the elimination or reorganization of emerging losers. Selection does not necessarily mean that individual firms must be "picked" for promotion; rather it means that sets of activities (in the broad sense) are chosen. The experience of other countries and the organic nature of capacity development can offer considerable guidance in this approach. A policy of protection can therefore be evolved that is systematically linked to patterns of structural change. At the same time, it is important to realize that protection by itself is not a remedy for high costs, inadequate training, institutional weakness, organizational deficiencies, or the lack of external support. Thus, selection must be part of a more global strategy which includes not only protection, but also capacity building and other supply-side measures. If the supply side is ignored, protection will only sustain and encourage inefficiency since firms will not be able to overcome those handicaps arising from the external environment.

The policy of selective intervention is therefore quite demanding. It requires that government be strong, competent, driven by economic objectives and able to analyse technological information and select activities which, given existing skills and financial and technological resources, can become efficient within a reasonable time-frame. Government should be able to monitor progress, ensure entry to foreign markets for domestic products and a degree of foreign competition at home, and act to remedy errors and eliminate loss-making initiatives. Most importantly, it should be able to foster progressively the capabilities and institutions that determine industrial efficiency.

These functions may not all be possible in African countries. Some governments may not be strong enough or pragmatic enough to manage such strategies. They may lack the human resources to mount the efforts needed in

analysis, supervision and promotion. The endowments with which they must work may be so limited that much of modern industry may be out of their reach for the foreseeable future. Under these conditions of high risk and insurmountable constraints, the market may indeed be the best arbitrator. The cost of government failure can be so high that many analysts tend to this view, at least in the African context. Yet, perhaps this view is too pessimistic. There are African countries with considerable industrial potential that have achieved some successes. In any case, intervention can, in principle, be very helpful in industrial development if it is truly selective and if it is well implemented (see Hyden 1983 for a sociological perspective).

Capabilities appear to be the area in which there is the greatest need for government action in Africa. Education and training are clearly necessary for all levels of industrial activity. Though many informal or small-scale industries may not require much organized technical training, literacy and some familiarity with advanced technologies are still obviously important. Furthermore, modern small-scale industry can involve highly sophisticated operations, and sustained expansion and upgrading will inevitably call for more vocational and technical training. Formal large-scale industry demands significant pools of well-trained workers, technicians, managers and engineers. It is imperative that governments provide the appropriate environment (Bennell 1984, World Bank 1988).

Intervention in the creation of skills is termed "functional", as opposed to "selective", if it is not aimed at the promotion of particular industries. However, this distinction is difficult to sustain once specialized education and training become involved. The skill requirements of different industries are highly specific, and technical personnel are not often interchangeable - a textile engineer is not normally employed to design electronic devices. The market may not always provide on time the skills which are eventually needed to achieve growth in individual industries. Therefore, if a government is seeking to promote particular industries, it may also have to intervene both selectively and functionally in education and training.

Given the extreme scarcity of trained manpower in Africa, over-training may be preferable to attempts to set precise targets in the creation of skills. This is what South Korea decided in the early stages of its modern development. The risk is that some skills will be lost to the brain drain, and others will remain under-used. However, once growth has picked up, skilled labour will find ready employment in all kinds of activity which planning cannot foresee.

Formal education should be substantially supplemented within firms through on-the-job training or other structured programmes. Again, to tailor skills to needs may call for government intervention by means of subsidies to firms or the direct provision of training facilities (as Singapore has done in collaboration with industry). On-the-job training requires experienced "tutors" since tacit skills are best transferred through hands-on demonstration and guidance. Foreign technicians, especially those seasoned in other developing regions, could play a particularly valuable role as tutors in African industry (Pack 1987). Although technical assistance in general has a poor record in Africa, the experience of some firms suggests that foreign technicians who stay for a considerable period (say three to five years) and work alongside educated Africans are fairly successful in imparting their know-how.

The provision by government of subsidies or of facilities for training may also be selective as well as functional in that certain types of industries may be especially targeted because of their externalities or their strategic significance in the production sector. Some activities may even be considered so important that government would be willing to use precious foreign exchange to send workers to plants and institutions abroad for rigorous training.

African governments must also stimulate technological activity relevant to manufacturing industries. A more competitive environment and a trimmer industrial structure, coupled with a larger supply of trained manpower, will of themselves provide a stimulus to efforts to progress in the assimilation of technologies. Nevertheless, their contribution can be enhanced through the implementation of incentives which encourage innovation and productivity. At least in the initial stages of development, firms will need help to acquire information, equipment, materials, consultants, and so on. Certain functions cannot be undertaken by companies alone because they are too "lumpy" or because they require too many externalities (public goods). Thus, only government has the ways and means to legislate standards, create testing institutions, provide technical-extension services, or conduct basic research. Only government can establish a science and technology infrastructure which links industry with laboratories, consultants, universities and foreign entities. In many African countries, where even basic quality-control and maintenance skills are lacking, functions normally performed within firms elsewhere may have to be provided by outside services which are shared. This approach would rationalize the use of precious expertise and furnish a training facility for technicians. Another important way to stimulate local

technological activity and the spread of know-how is the promotion of consultancy services, which would become repositories of the technical knowledge gathered from experience in a variety of enterprises.

Two areas of industry call for special strategies. The first is the engineering industry, and the second is subcontracting between large firms and small suppliers. Basic metalworking skills are generic to a whole host of industries, and the capacity to build, copy, repair, or otherwise improve capital goods even of a simple sort is widely regarded as the seed-bed and hub of technological progress (Fransman 1986). These skills are scarce in most African countries, adding to the difficulty of utilizing existing stocks of capital goods efficiently and raising productivity. The inability to make spare parts or carry out troubleshooting locally adds greatly to operating costs and the amount of time equipment lies idle. Meanwhile, the informal sector has shown considerable ingenuity in some metalworking jobs (tooling) and repair (automobiles). If the level of skills and know-how can be raised to that required for more modern small-scale industrial-engineering activity, these areas could achieve dynamic growth and facilitate growth in other areas.

In general, subcontracting and inter-firm linkages have been slow to develop in Africa. This reflects the lack of capabilities on the part of large firms, which must expend considerable effort and transfer a great deal of expertise and technology to set up subcontracting services, and potential suppliers, who do not possess the entrepreneurial and basic technical skills to be viable or reliable. It also reflects the poor condition of the infrastructures necessary for small firms, biases in policy and in credit markets and the absence of technical-extension networks. Governments should try to remedy these deficiencies and correct existing biases, while encouraging large firms to establish local subcontracting services. Such services can be a potent tool for the diffusion of technologies and skills and the promotion of small-scale industries, but they should not be created too hastily: the appearance of inefficient local suppliers would not be conducive to healthy development.

The broader economic picture should not be forgotten (Gulhati and Sekhar 1982). To quote from an earlier paper (Lall 1989: p. 155):

"The process of developing industrial capabilities is self-reinforcing, with different elements interacting to support each other. The general industrial environment affects its content and direction: a competitive, outward-looking regime is likely to call forth an appropriate set of technological responses. The rate and continuity of economic growth affect the speed of development: sustained rapid growth enables new technologies to

be deployed and enables faster learning to occur. It also permits firms to take long-term risks and invest in the gradual build-up of local capabilities. An assured supply of foreign exchange, similarly, allows a more rapid and smooth acquisition of technologies from abroad. These broader economic considerations, while not part of an industrial restructuring programme as such, should be kept in mind when reviewing the feasibility of industrial development in Sub-Saharan Africa."

If macroeconomic policies and incentives are improved and sufficient foreign resources are provided to enable Africa to resume a long-term growth strategy, the ultimate determining factors in the success or failure of industrialization in the region will be education and training, the supply of technically-skilled manpower and investments in the acquisition of new technologies within enterprises. Aid donors and multilateral institutions can play an important role in these areas.

That Africa requires increased foreign resource inflows to sustain a development process well into the next century is widely accepted. If combined with the policies described here, a stable store of foreign exchange and more predictable market conditions would greatly help in industrialization. However, the form which aid and resource inputs take is also important. Direct foreign investment can be a major provider of capital, skills and technology and can be used to establish linkages which would generate valuable spin-offs within local economies. Yet, its record in stimulating capacity building in Africa is rather mixed (see Navaretti forthcoming). Furthermore, the region has not been able to attract much foreign manufacturing in the past, and two factors suggest that its position is unlikely to improve. First, most investments in manufacturing have been furnished to profit from highly protected domestic markets. If African governments adopt more discriminating and limited protective strategies, some investors may well be discouraged. Second, there has been a switch in direct investment flows in the 1980s from developing to developed countries, and, within the former, to those countries which are more stable and better endowed with trained manpower and infrastructures. This further threatens to increase Africa's marginalization.

Therefore, concessional aid may have to play a correspondingly larger role. What form should it take? Clearly, programme aid for human resource development should have precedence, along with the technical assistance needed to raise levels of education, training and the assimilation of technologies. Infrastructure development should come next, preferably in the form of project aid. The rehabilitation of industry and new industrial projects should be undertaken only within a coherent programme of skill upgrading and

institutional support. The provision of assistance in policy formulation and institution building would be valuable if governments are willing to accept it. In general, aid linked with policy reform and more international market orientation is the best path for the provision of resources to Africa.

However, aid donors should clearly realize that there cannot be any "quick fixes" for the problems of industrialization in Africa. Some incentive-based approaches seem to be founded on the idea that simply getting prices right will be enough to launch Africa on the road to sustained development, while African governments themselves have looked to massive infusions of cash to get growth moving. Such approaches can be misleading and counter-productive although they contain elements which are necessary for healthy long-term industrialization. On the other hand, merely training people and building institutions would not be fruitful. Only the right combination of policy incentives, capabilities and institutions, supported by a conducive macroeconomic environment, will be successful. This combination cannot be achieved quickly for several reasons: institution building and human-resource development are gradual processes, and attempts to accelerate them may lead to sharp deteriorations in quality; one aspect of the acquisition of skills is experience on the job, and little can be done to boost this artificially except in highly inefficient operations; perhaps most important, all of these areas call for levels of government competence, dedication and effort that are difficult to attain.

Given, then, that there is no easy fix, it is imperative that management capabilities be built up so that whatever strategy is chosen may be effectively implemented. The extent to which this is feasible is an open question which is certainly beyond the scope of this paper. The political aspects of the situation may well dominate the economics, but if rationality and good advice (and the powerful example of the NICs) prevail, economic considerations will ultimately determine the path to be taken. In that event, the broad approach proposed here should be applied, rather than the half-way measures currently in vogue.

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